

PRELIMINARY REPORT  
RETURN FLOW STUDY OF DUCHESNE RIVER  
1974

PREPARED BY  
DIVISION OF WATER RIGHTS

## STATE OF UTAH

● Salt Lake City

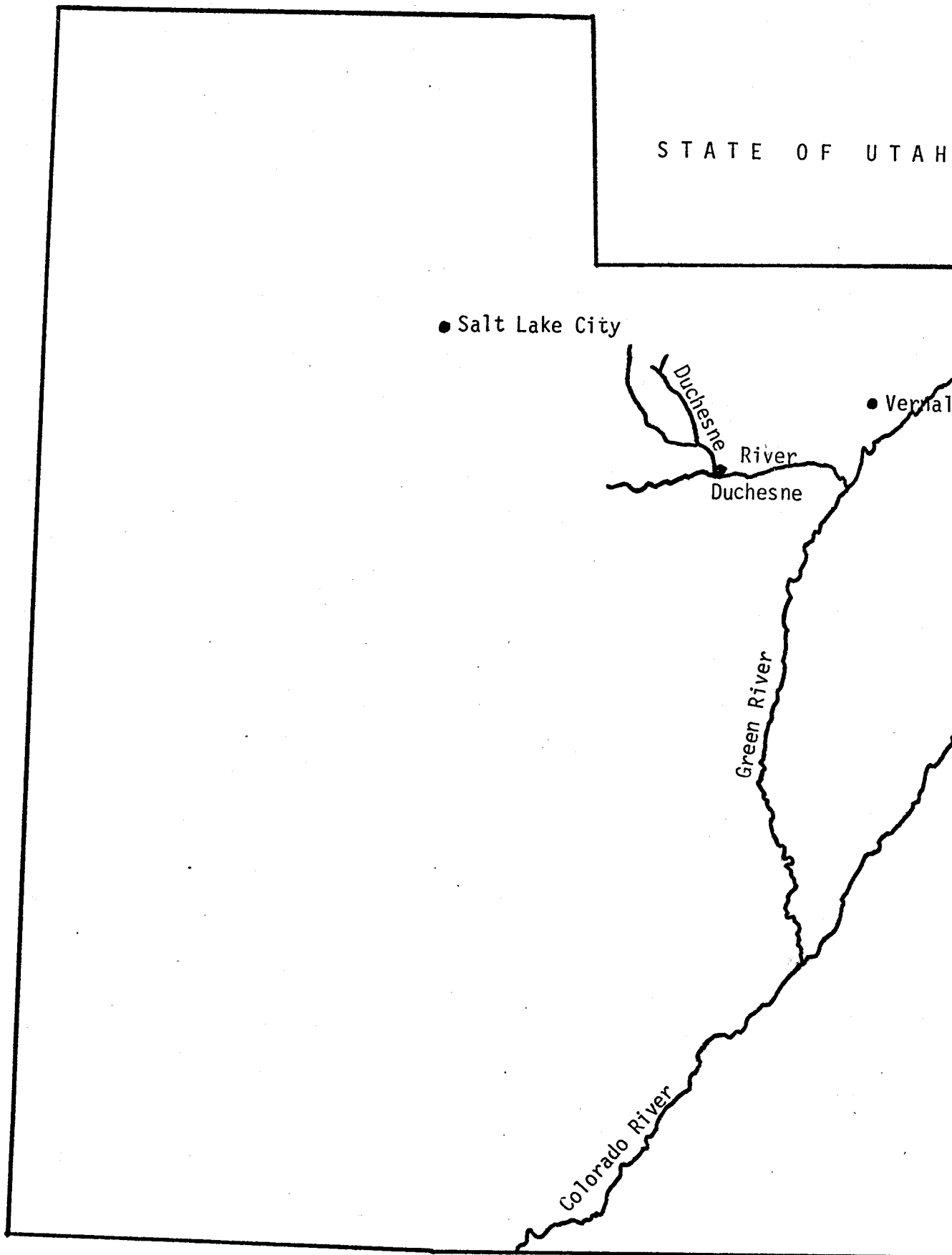
● Vernal

River

Duchesne

Green River

Colorado River



## I. Introduction

The duty of water on the Duchesne River System has been the subject of repeated discussion in past years. On January 26, 1974, the duty question was one of the topics in a hearing before the Fourth Judicial District Court. Those in attendance were in general agreement that every effort should be made to determine the duty of water to be allocated from the Duchesne River as soon as practicable.

The quantity of water which returned to the natural channel after diversion and use of the water to irrigate adjacent lands is one facet of the duty question which has been of concern to the users and upon which it did not appear that there was sufficient factual data available. To assist the water users and the Court in the resolution of this problem, the State Engineer agreed to start gathering data in an effort to determine return flow on this system and to arrive at a depletion figure applicable to the canals diverting water from the Duchesne River. This investigation, of course, was to be framed within the budgetary and staff limitations of the Division of Water Rights. The discussion which follows is the result of the State Engineer's investigation into the matter.

## II. Physiography of Basin

The Duchesne River heads in the Uinta Mountains in northeastern Utah at elevations approaching 12,000 feet and trends generally southeasterly to its confluence with the Green River at an elevation of approximately 4,700 feet. The glaciated slopes of the Uinta Mountains, the steep narrow canyons, and the lack of a deep soil-retaining mantle gives the Duchesne River a runoff pattern of high spring flows and rapidly dropping summer flows; e.g., 4,420 second-feet was measured June 10, 1922, and 15 second-feet was measured July 11, 1931, near Duchesne City. A hydrograph of the West Fork below Dry Hollow and the Duchesne River near Tabiona for the year 1958 (which is close to an average year) is included as Chart 1 on Page 10 of this report.

The Duchesne River Valley was formed by alluvial material carried by the Duchesne River and its many tributaries and deposited in the narrow confines of the steep side slopes bordering the river or as alluvial fans at the mouths of the many small intersecting canyons.

The development of irrigated land has generally been confined to these areas of deposition with construction of canals along the topographic high borders of these arable lands and the irrigation being applied adjacent to the main river, particularly in the portion of the canyon above the Town of Duchesne.

### III. Scope of 1974 Investigation

The threshold question for this return flow investigation was to divide the river system into hydrologic segments which could be managed and which would yield information on the question. At the beginning of the 1974 irrigation season, a reconnaissance of the Duchesne River was made, and a section of the river about 54 miles long was selected for study which begins part way up the two main tributaries, the North Fork and the West Fork, as follows:

1. From the confluence of the North Fork and Haydes Creek.
2. From the confluence of the West Fork and Dry Hollow.

From these two points the section extends downstream to the crossing of Highway 40 and the Duchesne River near Myton. It was felt that this was an area where the water supply and diversions could be measured with minimum interference from headgate changes, rain, irrigation changes, and fluctuations in stream flow, and could be correlated with measurements of stream gages maintained by the United States Geologic Survey.

This section of the river was then divided into four reaches. These four reaches are as follows and are illustrated on a map as Chart 2 on Page 11 of this report.

1. Reach 1 covers about 10 miles and begins part way up the two main tributaries, the North Fork and the West Fork, as follows:
  - A. From the confluence of the North Fork and Haydes Creek.
  - B. From the confluence of the West Fork and Dry Hollow.

From these two points the section extends downstream to the bridge across the Duchesne River near the Town of Hanna.

2. Reach 2 covers about 15 miles and extends from the bridge across the Duchesne River in the Town of Hanna to the bridge on Highway 35 across the Duchesne River approximately 8 miles southeast of Tabiona.
3. Reach 3 covers about 10 miles and extends from the bridge across the Duchesne River about 8 miles southeast of Tabiona to the bridge on Highway 35 across the Duchesne River about 4 miles downstream from the confluence of Rock Creek and the Duchesne River.
4. Reach 4 covers about 19 miles and extends from the bridge on Highway 35 across the Duchesne River about 4 miles below the confluence of Rock Creek and the Duchesne River to the gaging station just below the crossing of Highway 40 and the Duchesne River near Myton.

Two series of measurements were made on this section of the river--the first on July 17 and 18, 1974, and the second on August 28 and 29, 1974. Hereinafter the process which involved the taking of this series of measurements will be referred to as a "run". Each run consisted of obtaining measurements of the river and tributaries at 13 points and the measurement of 47 canals and ditches. Personnel involved in these runs were Donald C. Norseth, Robert F. Guy, and Gary Cupp of the Division of Water Rights and David Clayburn, Duchesne River Commissioner. Personnel of the United States Geologic Survey, Nick Panas, Leon Jensen, and Dale Webb, provided stream-gaging data and measurements which were very helpful in correlating stream flow. Leo Brady of the Central Utah Project provided the Strawberry River inflow to Starvation Reservoir and releases from the reservoir.

During the runs it was found that attempting to determine the return flow from each canal was impractical because the water from the upper canals was observed flowing over the ground surface into other canals before reaching the river. The influence of irrigation onto the river-adjacent lands on stream flow was impracticable to evaluate at the times of the runs because infiltration into the river from irrigated lands, inflow from springs, swamps, and small tributaries could not be separated and identified. The field work in 1974 was expended in measuring the river and the canals and ditches to determine the effect that the diversion of water had on the flow of the Duchesne River in the selected reaches. A graphic flow chart of the section is included as Chart 3 on Page 12. The measurements made during 1974 for the four reaches are tabulated below

#### IV. Tabulation of 1974 Measurements

##### Reach 1:

Place of Measurement	c.f.s.	c.f.s.
<u>First Run</u>		
<u>Streamflow:</u>		
Big Springs Area	10.4	
West Fork below Dry Hollow	24.5	
Wolf Creek below Rhoades Canyon	10.2	
North Fork below Haydes Creek	48.4	
Total		93.5
<u>Diversions:</u>		
Orven J. Moon No. 1 (322)	0.0	
Orven J. Moon No. 2 (322)	0.0	
Orven J. Moon No. 1 (320)	3.0	
Orven J. Moon No. 2 (321)	3.0	
Orven J. Moon No. 3 (217)	2.9	
Orven J. Moon No. 4 (241)	2.9	
Orven J. Moon No. 3 (322)	3.0	
Willis Moon (282)	5.0	
Alfonzo Defa	6.0	
Tayne Wilkens	0.5	
McAfee (Swift Creek)	6.0	
Big Springs	6.9	

Place of Measurement	c.f.s.	c.f.s.
Rhoades	38.1	
Turnbow	3.6	
unnamed	1.5	
Total		82.4
<u>Second Run</u>		
Streamflow:		
Big Springs Area	6.1	
West Fork below Dry Hollow	12.1	
Wolf Creek below Rhoades Canyon	7.8	
North Fork below Haydes Creek	30.5	
Total		56.5
Diversions:		
Orven J. Moon No. 1 (322)	0.0	
Orven J. Moon No. 2 (322)	0.0	
Orven J. Moon No. 1 (320)	0.0	
Orven J. Moon No. 2 (321)	1.5	
Orven J. Moon No. 3 (217)	0.0	
Orven J. Moon No. 4 (241)	0.0	
Orven J. Moon No. 3 (322)	1.5	
Willis Moon (282)	0.2	
Alfonzo Defa	2.0	
Tayne Wilkins	no measurement	
McAfee (Swift Creek)	no measurement	
Big Springs	3.6	
Rhoades	19.6	
Turnbow	2.0	
Total		30.4

## Reach 2:

Place of Measurement	c.f.s.	c.f.s.
<u>First Run</u>		
Streamflow:		
Duchesne River at Hanna	76.0	
Farm Creek	3.0	
Total		79.0
Diversions:		
Orven N. Moon (211)	0.0	
Defa (244)	0.0	
Little Farm Creek	2.7	
Farm Creek	44.9	
Jessop Thomas	0.0	
Jasper Pike	19.0	
Tabby	34.9	
Jim Bridger	abandoned right changed to Tabby	
Hicken	12.4	

Place of Measurement	c.f.s.	c.f.s.
Wagstaff	4.0	
Brown	3.9	
Jesse Peterson (Abplanab)	1.8	
Total		123.6
<u>Second Run</u>		
Streamflow:		
Duchesne River at Hanna	58.0	
Farm Creek	2.0	
Total		60.0
Diversions:		
Orven N. Moon (211)	0.0	
Defa (244)	0.0	
Little Farm Creek	2.0	
Farm Creek	31.7	
Jessop Thomas	3.6	
Jasper Pike	17.4	
Tabby	18.1	
Hicken	8.5	
Wagstaff	2.2	
Brown	2.0	
Jesse Peterson (Abplanab)	1.0	
Total		86.5

## Reach 3:

Place of Measurement	c.f.s.	c.f.s.
<u>First Run</u>		
Streamflow:		
Duchesne River near Tabiona	102.0	
Rock Creek near Talmage	158.0	
Total		255.0
Diversions:		
Broadhead	17.0	
Jones No. 1	2.0	
West Rock Creek	1.5	
Indian (James Mountain)	1.5	
Knight	8.0	
Shanks	9.5	
Pioneer	26.3	
Total		65.8
<u>Second Run</u>		
Streamflow:		
Duchesne River near Tabiona	93.0	
Rock Creek near Talmage	60.7	
Total		152.7

Place of Measurement	c.f.s.	c.f.s.
Diversions:		
Broadhead	7.5	
Jones	1.2	
West Rock Creek	1.4	
Indian (James Mountain)	1.0	
Knight	5.5	
Shanks (7.0 c.f.s. is project water)	11.0	
Pioneer	26.7	
Total		54.3

Reach 4:

<u>First Run</u>		
Streamflow:		
Duchesne River about Knight Diversion	193.0	
Strawberry River above Starvation Res.	85.0	
Starvation Reservoir Storage Release	309.0	
Total		587.0
Diversions:		
Knight Diversion	0.0	
Murray-White	16.0	
Rocky Point	51.8	
Madsen	3.0	
Yannaward (City Ditch)	3.0	
Porter Merrill Pump	0.0	
Child (not being used)	0.0	
Hamilton (Hollenbeck)	6.0	
Meacham	0.0	
Duchesne Feeder	160.0	
Grey Mountain	270.0	
Pahcease (diverting through Duchesne Feeder)		
Myton Townsite	122.5	
Total		633.2
<u>Second Run</u>		
Streamflow:		
Duchesne River about Knight Diversion	92.0	
Strawberry River above Starvation Res.	46.0	
Starvation Reservoir Storage Release	306.0	
Total		444.0
Diversions:		
Knight Diversion	0.0	
Murray-White	19.0	
Rocky Point	45.0	
Madsen	1.5	
Yannaward (City Ditch)	4.5	
Porter Merrill Pump	0.0	
Child (not being used)	0.0	

Place of Measurement	c.f.s.	c.f.s.
Duchesne City	3.0	
Hamilton (Hollenbeck)	4.0	
Meacham	6.5	
Duchesne Feeder	129.0	
Grey Mountain	255.0	
Pahcease (diverted through Duchesne Feeder)		
Myton Townsite	59.0	
Total		526.5

### V. Summary of 1974 Measurements

1	2	3	4	5	6	7	8	9	10	11
Reach	Run	Inflow <sup>1/</sup>	Diverted	Outflow <sup>2/</sup>	Flow <sup>3/</sup>		Flow Increase		Flow Increase	
		c.f.s.	c.f.s.	c.f.s.	Depletion	Increase			In Reach <sup>4/</sup>	
					c.f.s.	%	c.f.s.	%	c.f.s.	%
1	1	93.5	82.4	76.0	17.5	18.7			64.9	69.4
1	2	56.5	30.4	58.0			1.5	2.7	31.9	56.5
2	1	79.0	123.6	102.0			23.0	29.1	146.6	185.6
2	2	58.0	86.5	67.2			7.2	12.0	93.7	156.2
3	1	255.0	65.8	193.0	62.0	24.3			41.5	16.3
3	2	152.7	54.3	92.0	60.7	39.8			-6.4	-4.2
4	1	587.0	633.2	175.0	412.0	70.2			221.2	37.7
4	2	444.0	526.5	47.4	396.6	89.3			129.9	29.3
Total Inflow in All Reaches from All Sources							Run 1:	474.2		
							Run 2:	249.1		
Average Percentage Increase of All Reaches							Run 1:	77.3		
							Run 2:	59.5		

<sup>1/</sup> Measured flow at top of reach.

<sup>2/</sup> Measured flow at bottom of reach.

<sup>3/</sup> Difference between Columns 3 and 5.

<sup>4/</sup> Increase or decrease in water supply due to inflow between measuring points at bottom and top of reach.

### V. Summary

The Duchesne River return flow study was partially completed during the 1974 irrigation season. The work was carried out in two phases during July and August when river flow and diversions were stable enough for measurement without large fluctuations. Field work was reconnoitering

the river area, selecting a section for study, and gathering basic data on stream flow and diversions to determine the effect of the diversions on river flow.

It was concluded that from the tabulation of measurements contained herein, stream accretion varied in quantity through the study section and consisted of inflow from (1) small tributaries, (2) spring flow, (3) river underflow, (4) conveyance losses, and (5) filtration from irrigated lands. The isolation and identification of these different sources was concluded to be impractical in this study. To provide what information is available at this time for all of the canals involved, a general estimate of the return flow is made considering the following parameters. If we assume the preliminary conveyance loss figures from the State Engineer's study of canal losses of 1971-1972 and that one second-foot per seventy acres supplies only the water needed by the crops, and keeping in mind that return flow cannot be isolated from underflow, a general estimate of return flow can be made as shown in Chart 4.

Chart 4. Estimate of 1974 Return Flow

Run	Reach 1 %	Reach 2 %	Reach 3 %	Reach 4 %	Average <sup>1/</sup> %
1	46	70	16	38	43
2	26	66	0	29	29

<sup>1/</sup>This estimate is probably on the low side as water applied to crops wasn't considered. It must be emphasized that the estimates set forth in Chart 4 are very preliminary and subject to revision as additional data is obtained.

The study showed the need for additional measurements to refine the 1974 data in the following respects:

1. To determine the contribution of Warm Springs and Big Springs to the river flow in Reach 1.
2. To determine the relative contribution of West Fork and North Fork to the Duchesne River.
3. To determine spring flow accretion in Reach 2 and to locate possible existing geologic barriers that could affect underflow.
4. To determine the contribution of Rock Creek to the Main River and check river loss in late summer in Reach 3.
5. To correlate water quality data with streamflow and diversion.

Chart 1

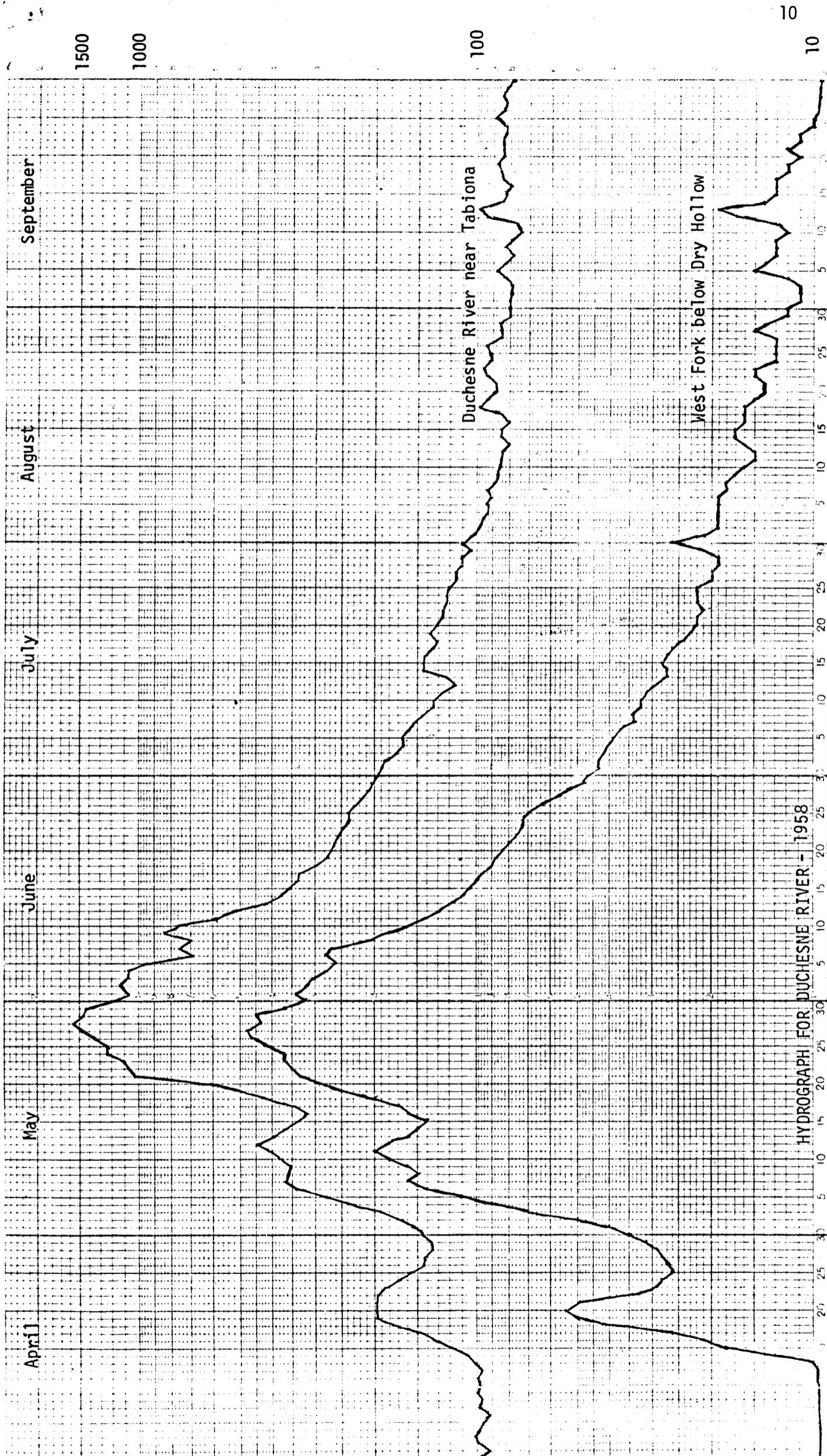


Chart 2  
DUCHESNE RIVER  
Study Section  
1974

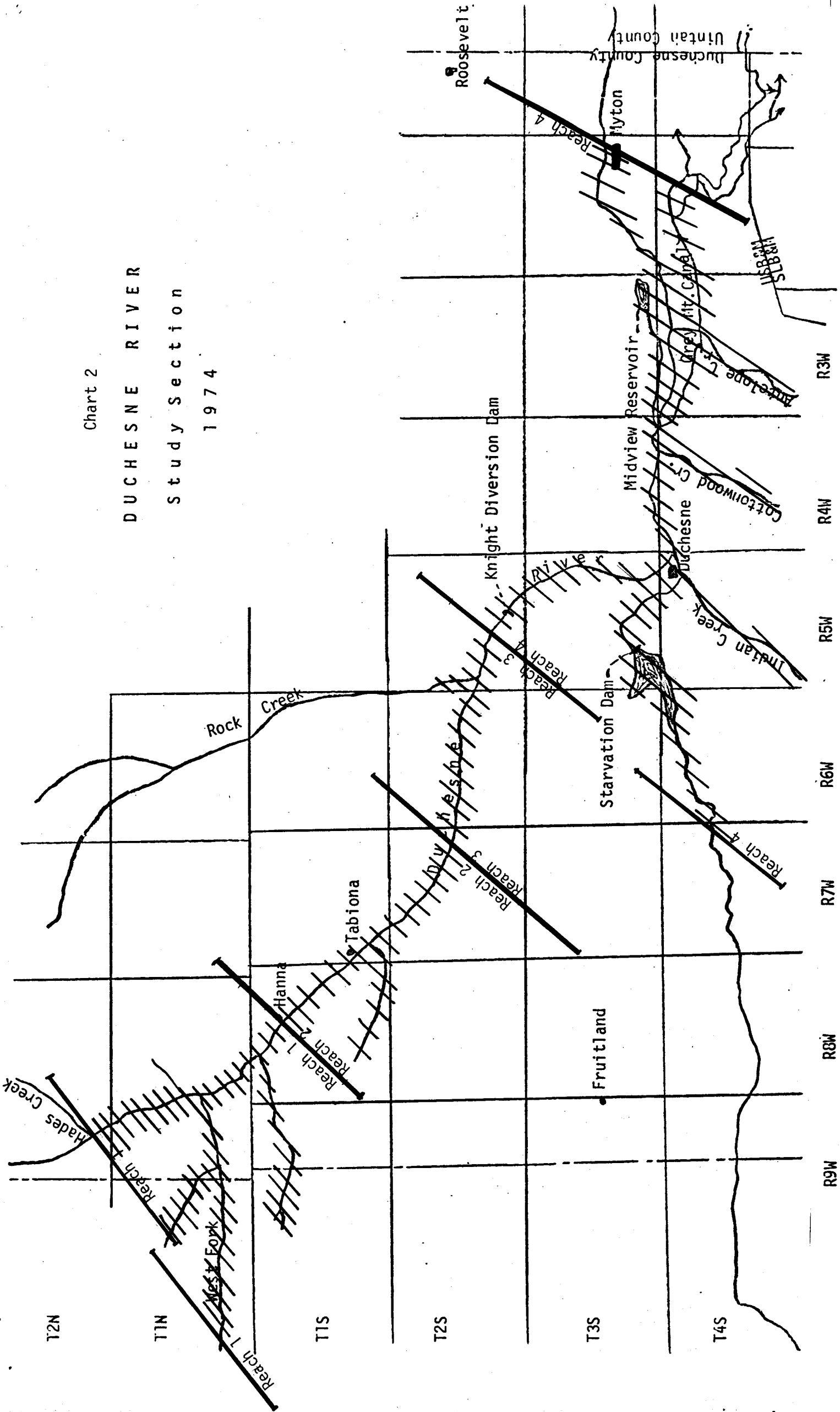


Chart 3  
FLOW CHART OF DUCHESNE RIVER STUDY SECTION

Scale 1 inch = 1000 c.f.s.

